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Article

## Assembling “Digital Literacies”: Contingent Pasts, Possible Futures

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### Abstract

In this article, we examine the historical emergence of the concept of “digital literacy” in education to consider how key insights from its past might be of use in addressing the ethical and political challenges now being raised by connective media and mobile technologies. While contemporary uses of digital literacy are broadly associated with access, evaluation, curation, and production of information in digital environments, we trace the concept’s genealogy to a time before this tentative agreement was reached—when diverse scholarly lineages (e.g., computer literacy, information literacy, media literacy) were competing to shape the educational agenda for emerging communication technologies. Using assemblage theory, we map those meanings that have persisted in our present articulations of digital literacy, as well as those that were abandoned along the way. We demonstrate that our inherited conceptions of digital literacy have prioritized the interplay of users, devices, and content over earlier concerns about technical infrastructures and socio-economic relations. This legacy, we argue, contributes to digital literacy’s inadequacies in addressing contemporary dilemmas related to surveillance, control, and profit motives in connective environments. We propose a multidimensional framework for understanding digital literacies that works to reintegrate some of these earlier concerns and conclude by considering how such an orientation might open pathways for education research and practice.

### Keywords

digital literacy; information literacy; literacies; media literacy; new literacies

### Issue

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### 1. Introduction

Digital literacy has now entered common parlance in education research, policy, and practice. Calls for inquiry into its associated activities and its place in pedagogical transactions abound (Hicks & Turner, 2013; Lankshear & Knobel, 2008). Yet, for its resonance in the field, the term’s meaning remains stubbornly nebulous. Broadly associated with the access, evaluation, curation, and production of information in digital environments, the phrase is used to index a range of scholarly projects: from studies of screen-based reading comprehension (Coiro, 2003; Leu & Kinzer, 2000) to accounts of youth

media practices (Haddix & Sealey-Ruiz, 2012; Ito et al., 2013) to applications of critical theory in the creation and consumption of digital artifacts (Ávila & Pandya, 2012; Morrell, 2012). Current contexts of participatory media (Jenkins, Ford, & Green, 2013) use the phrase in its plural form, “digital literacies,” to reflect the multiplicity of situated social practices that are mediated through digital technologies (Pahl & Rowsell, 2010). Taken together, these diverse meanings have allowed the term to circulate widely, leading to what some have called the “digital turn” in literacy studies (Mills, 2010). However, in consolidating such diverse trajectories under the banner of “digital literacy,” at times the phrase can

paper over differences and contradictions within and across its uses. These tensions are only further compounded as the contours of our digital ecosystem continue to evolve with the proliferation of connective and mobile technologies.

In this article, we examine the historical emergence of digital literacy in education to suggest that insights from its past can be of use not only in clarifying its present configurations but also in addressing the ethical and political challenges surfacing with contemporary connective media. To do so, we begin by tracing the genealogy of digital literacy from a time before the term found popular uptake, when diverse scholarly lineages were still competing to shape an educational agenda for new computer technologies. We suggest that digital literacy was not an inevitable successor to these traditions but a contingent assemblage that braided together certain concerns from the past while abandoning others. We argue that this assemblage has conditioned our inherited models of digital literacy—those that are now straining to accommodate, much less explicate, the technical and economic infrastructures that underwrite digital practices. Drawing on resources from the term's longer histories and the work of contemporary media theorists (e.g., Berry, 2011; van Dijck, 2013), we propose an expanded framework for mapping the multidimensional terrain of digital literacy—one that brings a socio-historical orientation to bear on the material and economic realities of digital practice. We conclude by considering how this multidimensional view might be put to work in education research and practice.

## 2. Contingent Histories of “Digital Literacy”

In the mid-1990s, before digital literacy had found its way into common usage, there was already a growing sense among literacy researchers that the shifting technological landscape was reshaping the demands of reading and writing. In a 1994 keynote address to the National Reading Conference, David Reinking argued that computers were ushering in a “post-typographic world”—one that would require new theories and methods for teaching and learning. “Evolving forms of electronic reading and writing,” he said, “point to fundamental changes in the way we communicate and disseminate information, the way we approach reading and writing, and the way we think about helping people become literate.” In just a few years, Reinking and others in the field would be using the phrase “digital literacy” to bind these challenges together as a coherent scholarly project (Labbo, Reinking, & McKenna, 1998; cf. Bawden, 2008); however, at the time, in the absence of such a framework, scholars looked instead to existing traditions in technology education to elucidate paths forward in the “post-typographic” age (cf. Baker & Luke, 1991; Hawisher, LeBlanc, Moran, & Selfe, 1996). Most prominent among these were computer literacy, information literacy, and media literacy.

### 2.1. Computer Literacy

Computer literacy had existed in some form since the 1970s, albeit with variations in its usage. One of the earliest government-funded surveys of the concept began by stating, “Computer literacy is a term that has been widely discussed, but whose meaning has rarely been agreed upon” (Lockheed et al., 1983, p. 12). Through the 1980s, two competing—though, at times, allied—approaches to computer literacy began to emerge. The first focused on uses of computer technologies. Moursund (1982), for example, suggested that elementary and secondary students ought to have practical knowledge about computers and their applications to life and work. Luehrmann (1982) articulated this view more colloquially, saying, “If you can tell the computer how to do things you want it to do, you are computer literate.” This orientation could include attention to hardware or programming, but it largely centered on the non-technical aspects of computer-use. The second approach, by contrast, was concerned with control of computer technologies. Papert (1980) famously suggested that children who could not program computers were at risk of being programmed by them. At the MIT Media Lab, he and his colleagues developed the LOGO programming language to support students in communicating with and manipulating computer environments. While both approaches coexisted into the 1990s, advocates of the latter became frustrated with the steady proliferation of the former in school settings. Papert (1992) accused use-driven orientations to computer literacy with redefining the term to mean “a very minimal practical knowledge about computers” and suggested “someone who had so minimal a level of knowledge of reading, writing, and literature would be called illiterate” (p. 52).

Importantly, as computers were integrated into school contexts throughout the 1980s, a third dimension to computer literacy also emerged—one focused on the politics and economics of computing systems. In a wide-ranging critique, titled “Computer Literacy and Ideology,” Noble (1984) argued that the ambiguities in the term were actually strategic, leveraging anodyne appeals to “preparing students for future work” or “empowering students to program” to advance a particular ideology. For Noble (1984), the use-oriented approach to computer literacy was rooted in technological determinism: by presupposing the inevitability of a computer-driven future, it not only created a sense of urgency for bringing computers into schools, but in doing so, accelerated a new credentials race, where computer-knowledge became a form of capital that could be shored up by or withheld from individuals to reinforce already-existing social hierarchies. Similarly, Noble argued that control-oriented approaches to computer literacy actually manifested a form of “pseudo-control”—allowing users to feel they are mastering a machine when, in reality, their thinking is becoming more tightly bound to its instrumental logic and protocols. Even more, Noble suggested

the differences between the varied forms of computer literacy were superficial. Whether students learned to use or control computers, both approaches necessitated more devices to be purchased, meaning there was also a profit-motive undergirding the demand for computers in schools. From this perspective, a comprehensive view on computer literacy ought to include attention to the political economy of computer culture. While positions like Noble's found resonance with some scholars (Mackay, 1992), by the mid-1990s, the most prominent approaches continued to emphasize use and control—and, for its ease of implementation and direct ties to the job market, most often just the former (Tyner, 1991).

## 2.2. Information Literacy

Information literacy took shape over the same timespan as computer literacy, but developed largely in the fields of library and information science. Given this disciplinary lineage, information literacy was less concerned with the use, control, or economics of computer technology than with the competencies required to make use of information in computer-based environments (Behrens, 1994). Horton (1983) delineates the differences between the two, saying:

Information literacy, as opposed to computer literacy, means raising the level of awareness of individuals and enterprises to the knowledge explosion, and how machine-aided handling systems can help to identify, access, and obtain data, documents, and literature needed for problem-solving and decision-making. (p. 16)

Put another way, information literacy bypassed technical concerns to focus on the production and organization of information itself, while recognizing that these demands were heavily inflected by the changing landscape of digital media.

In education, this meant information literacy was not to be a new addition to the curriculum—as some computer literacy champions advocated—but an update and extension of existing instruction related to research skills and library use. For this reason, most internal debates about the concept centered on which information-seeking skills, strategies, and dispositions ought to be emphasized (Snively & Cooper, 1997). Throughout the 1980s, scholars and professional organizations issued competing taxonomies to delineate these priorities. The American Library Association (1989), for example, defined the key components of information literacy as: (1) recognizing the need for information; (2) identifying what information would address a particular problem; (3) finding the information needed; (4) evaluating the information found; (5) organizing the information; and (6) using the information effectively in addressing the specific problem. Others curated alternate lists, augmenting these themes with more detailed cri-

teria for navigating hypertext and conducting digital searches. Bawden's (2001) survey of the field found more than a dozen of these information literacy classification systems in circulation by the 1990s. In contrast with computer literacy, however, the differences between these perspectives were negligible. Each categorization diverged in its specificity and points of emphasis, but there remained a broad consensus that information literacy was, at its core, concerned with assembling knowledge by retrieving, organizing, and evaluating information (cf. Koltay, 2011).

## 2.3. Media Literacy

Like information literacy, media literacy emerged in the 1970s as an extension of earlier research traditions—in this case, the postwar investment in education related to propaganda analysis, general semantics, and visual rhetoric (Glander, 2000; Hobbs & McGee, 2014). Scholars often delineate two strands from these traditions that converged as media literacy became formalized into a cohesive project: protectionism and empowerment (Hobbs, 1998; Robbgrieco, 2014). The protectionist strand, drawing from propaganda studies, is concerned with shielding students from media manipulation. In this sense, it shares similarities with information literacy by applying critical evaluation to ascertain information quality, but extends such analyses to a broader range of media artifacts (Hobbs, 2006). Throughout the 1980s, this work took the form of “critical viewing” programs, which provided strategies for navigating visual environments and warding off negative media effects (Brown, 1991). However, some found the focus on protection to be overly narrow, ignoring the ways media literacy might empower students not only in evaluating media messages but in producing their own (Tyner, 1998). Desmond (1997) would later refer to these as the “deficit” and “acquisition” orientations toward media literacy. By the early 1990s, frameworks for media literacy worked to incorporate both of these dimensions—including the widely-cited definition that resulted from the 1992 National Leadership Conference on Media Literacy: “The ability to access, analyze, and evaluate, and communicate messages in a variety of forms” (Aufderheide, 1993, p. 6).

While protectionism and empowerment have played important roles in media literacy, they are not the only frames for mapping the concept's historiography. As with computer literacy, there were rival perspectives that ran parallel to these—even if they did not find so wide an audience. Media theorists Marshall McLuhan (1977) and Neil Postman (1979) each outlined curricula that would help students examine media ecologically—not just evaluating and creating messages, but studying the material and social implications of media environments, from speech and writing to television and computers. Others worked to shape forms of critical media literacy, which applied economic and political analysis to communica-

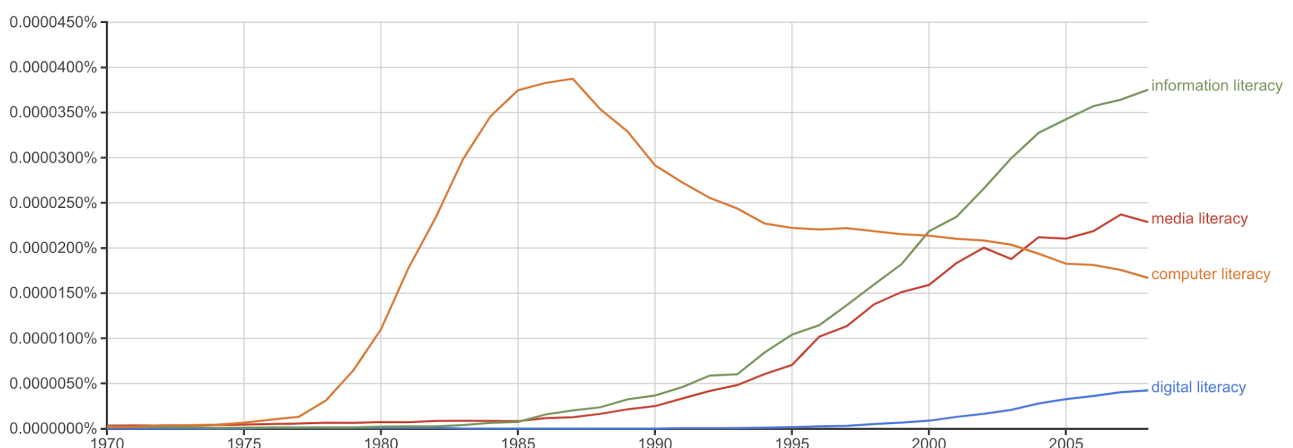
tion systems (McLaren, Hammer, Sholle, & Reilly, 1997). Kellner (1998) saw this approach as a way to augment computer literacy with insights from more general studies of media, saying, “students should learn new forms of computer literacy that involve both how to use the computer to do research and gather information, as well as to perceive it as a cultural terrain that contains texts, spectacles, games, and new interactive multimedia” (p. 116). Even today, there continue to be calls for more expansive understandings of media literacy—particularly those that move beyond analysis and creation of media artifacts to interrogate broader issues of governance and production in new media environments (cf. Bulger & Davison, 2018).

By the mid-1990s, just before digital literacy had found a foothold in public discourse, these orientations—computer literacy, information literacy, and media literacy—were among the most prominent resources available to those, like Reinking, who were straining to name and describe the incipient challenges for reading and writing in a “post-typographic world.” Scholars at the time were actively combining insights from these lineages to synthesize a coherent agenda for education research and practice. Many of these configurations yielded new and competing terminologies: network literacy (McClure, 1994), mediacy (Inoue, Naito, & Koshizuka, 1997), informacy (Neelamaghan, 1995), comperacy (McMillan, 1996), e-literacy (Kope, 2006). Among these rival perspectives, digital literacy began to emerge

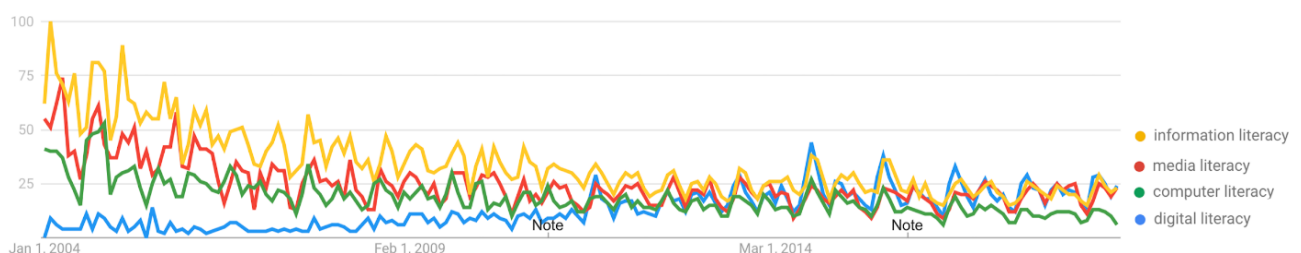
as a preferred term. Writing with colleagues in 1998 on the same topic as his previous National Reading Conference keynote, Reinking now used the phrase explicitly, saying, “during the ensuing decades, the importance of aligning digital literacy instruction in the classroom with its applications in larger society will become ever more imperative” (Labbo et al., 1998, p. 275). Google NGram and Trends searches show this uptake among literacy scholars to be consistent with the broader rise of digital literacy in popular usage—at first, marginal in comparison with its conceptual predecessors (Figure 1) but eventually outpacing them (Figure 2). In what follows, we consider how digital literacy took shape from these lineages and emerged as a contingent assemblage that continues to condition our approaches to research and teaching.

### 3. Digital Literacy as Assemblage

As we have suggested, digital literacy was not the inevitable successor to earlier traditions of computer, information, and media literacy. It surfaced in the mid-1990s, amid competing terminologies, as an available resource, adaptable to a range of scholarly and pedagogical challenges. Importantly, the emergence of digital literacy did not mark a clean break from these predecessors, but consolidated recognizable features from each into a tenuous new program. In this sense, digital literacy can be understood less as a bounded concept and more as an assemblage—a layering together of historical meanings



**Figure 1.** Google NGRAM of usage patterns for computer, information, media, and digital literacy between 1970 and 2008.



**Figure 2.** Google Trends depiction of usage patterns for computer, information, media, and digital literacy from 2004 to 2018.

and practices that have congealed, for the moment, into a useable discourse. DeLanda (2006) extends Deleuzian notions of assemblage to include the encoding of linguistic formations—like “digital literacy”—arguing that such convergences are part of the “nonlinear histories” (DeLanda, 1997) that constitute and animate the present. By tracing the nonlinear history of digital literacy and its contingent unfolding over time, we can understand and articulate the tensions the term has inherited—and perhaps revive resources from its past that can assist us imagining new directions going forward.

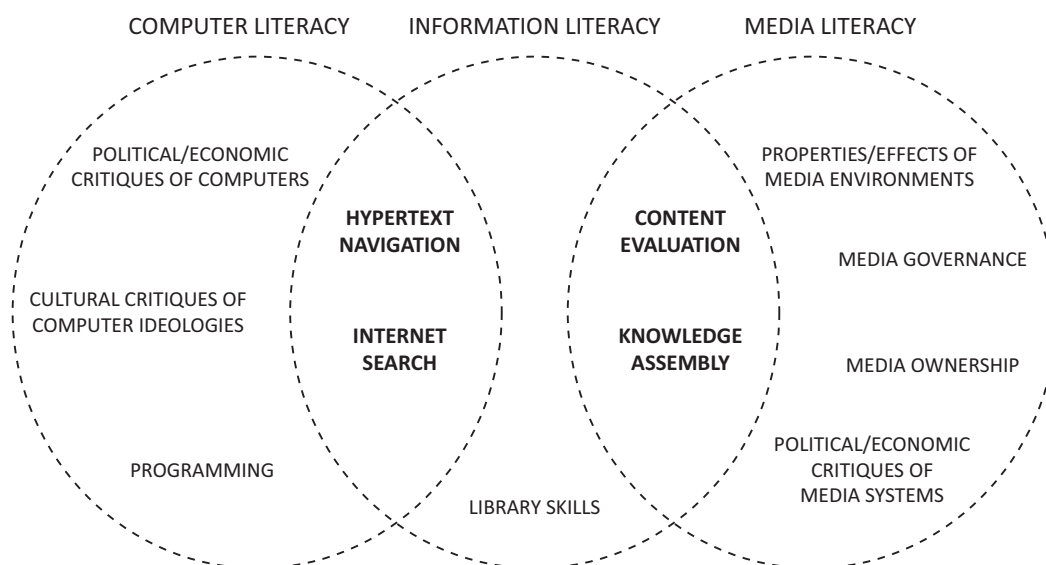
While the phrase digital literacy was used occasionally throughout the early 1990s (e.g., Lanham, 1995; LeBlanc, 1990), it entered wider circulation with the publication of Paul Gilster’s (1997) *Digital Literacy*. Much of the literature that followed over the subsequent decade would explicitly reference this lineage in grounding the use of the term (cf. Bawden, 2008). Gilster opened the book by acknowledging that the concept “extends the boundaries of definition” (1997, p. 1), but offered a general sketch of its meaning:

Digital literacy is the ability to understand and use information in multiple formats from a wide range of sources when it is presented via computers....It is cognition of what you see on the computer screen when you use a networked medium. It places demands upon you that were always present, though less visible, in the analog media of newspapers and TV....Not only must you acquire the skills of finding things, you must also acquire the ability to use these things in your life. (1997, pp. 1–2)

Within this description, we see components from traditions already in circulation being woven together under the banner of digital literacy: navigating and using com-

puters and networks (computer literacy); finding and evaluating information (information literacy); and considering how messages are consumed and produced (media literacy). Such overlaps are even more pronounced in Gilster’s taxonomy of digital literacy competencies, (1) Internet search, (2) hypertext navigation, (3) knowledge assembly, and (4) content evaluation. Each of these marks an intersection of the most common uses for computer, information, and media literacy. Mapping these junctures (Figure 3), we are able to see how digital literacy, as configured by Gilster, braided together concepts from across these lineages, allowing a particular constellation of focal concerns to emerge. Importantly, we are also able to see the contingencies of this process, as certain components from previous traditions were not actively incorporated into the new assemblage taking shape.

These points of emphasis remained central to digital literacy, even as critical appraisals and redirections surfaced in the mid-2000s. Most historiographies of digital literacy delineate a second wave of scholarship, informed by sociocultural literacy studies (Street, 1995), that adopted a pluralized form, “digital literacies,” to signal a shift from normative skill-acquisition to more descriptive accounts of digital activities situated within social, cultural, and political contexts. Lankshear and Knobel open their 2008 edited volume, *Digital Literacies*, by suggesting operational uses of the term ought to be replaced with inquiry into the cultural practices emerging around computer technologies. This reframing sought to alter the composition of digital literacy from the normative competencies outlined in Gilster by shifting the vantage point from which literacy practices were studied. Rather than prescribing skill-based taxonomies for “knowledge assembly,” for example, researchers worked to describe the ways people were assembling knowledge with digital media: from producing digital stories (Hull



**Figure 3.** Gilster’s taxonomy of digital literacy, emerged at the common intersections of computer, information, and media literacy traditions.



& Katz, 2006) to constructing meaning through video games and virtual worlds (Gee, 2003). Work in this vein has been integral in challenging conventional wisdom related to young people's technology use by documenting the strategic ways youth take up digital media (e.g., boyd, 2014; Ito et al., 2013). Likewise, it has opened pathways for examining how digital media practices are bound up with broader forms of social participation: from fans "re-storying" pop culture artifacts to challenge dominant ideologies (Thomas & Stornaiuolo, 2016) to LGBT youth using social media to cultivate personal and community identities (Wargo, 2015). It has also provided avenues for incorporating descriptive findings back into school-based settings in ways that support student flourishing, especially those from nondominant communities (Garcia et al., 2014; Price-Dennis, 2016).

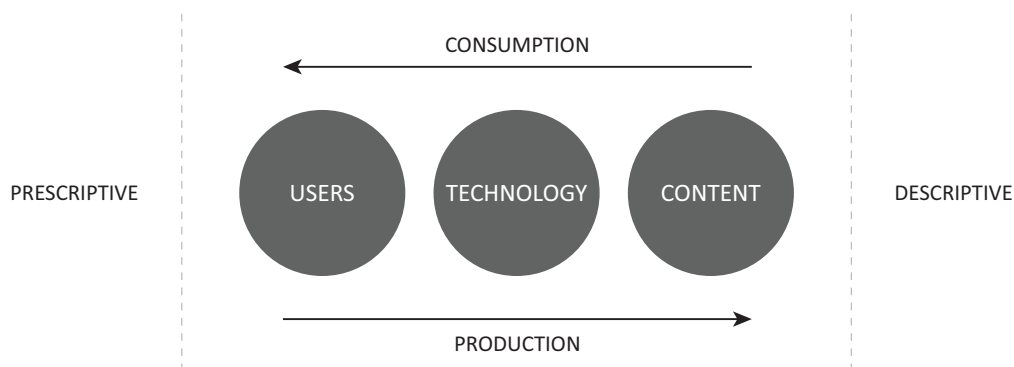
By attending more closely to people's social practices with digital technologies, the shift from prescriptive to descriptive views of digital literacies has played a vital role in expanding the field beyond its early focus on skill-development. This is not to suggest that skill orientations have receded entirely: in policy and curricula documents, it remains common to see taxonomies prescribing the competencies needed for students to become "digitally literate" (e.g., Deye, 2015; UNESCO, 2018). But broadly, the reorientation toward social practices has changed the vantage point from which research on digital literacies is conducted. What has not changed, however, are the central components of digital literacy—those core elements first assembled together in the mid-1990s. Both then and now, digital literacy (and digital literacies) has remained centrally concerned with the ways *users* (e.g., individuals, groups, communities) leverage *technologies* (e.g., computers, software, mobile devices) to consume or produce *content* (e.g., textual, visual, multimedia artifacts; Figure 4). Where prescriptive accounts might differ from descriptive ones in delimiting normative strategies for engaging in configurations of these elements, both operate within a framework that takes these components as their primary focus.

We do not highlight this as an admonishment: as we have suggested, the present model of digital literacies, with its expanded view of social practices, con-

tinues to offer generative avenues for research and pedagogy—indeed, both authors locate facets of their work within this framework. But with the proliferation of connective media and mobile technologies, there are times when our inherited models of digital literacies—focused on the skills and social practices of individuals—strains to accommodate the political and economic flows that underwrite contemporary digital activities. A growing body of education research, for example, points to the imbrication of localized digital media use with the governance strategies of policymakers (Davies, Eynon, & Wilkin, 2017), the data-collection practices of corporate owners (Williamson, 2017), and the protocols established by software developers (Lynch, 2016; Scott & Nichols, 2017). While existing models can offer strategies for navigating hypertext or rich accounts of situated social practices in digital environments, they are less adept at explaining the relations between these activities and the technical and economic infrastructures that condition them. In what follows, we consider how resources from those lineages that preceded our present model of digital literacy might be of use in expanding the term's terrain to address our connective media landscape.

#### 4. Reassembling Digital Literacies

In tracing the contingent histories of digital literacy, we have identified several lines of inquiry which prefigure contemporary concerns around issues like privacy, surveillance, and data infrastructures. For example, computer literacy scholarship that advocated familiarity with coding and algorithmic reasoning (Papert, 1980) or that critiqued the political economy of computer culture (Noble, 1984) speak to some of the core tensions that now surface in education research on connective technologies. The first of these relates to the *socio-technical dimension* of digital media. Where our present model of digital literacy tends to treat "technology" as discrete objects—computers, tablets, mobile devices—Papert drew attention to the internal mechanisms that allow devices to function. Such an approach becomes even more salient today, where "code" is no longer limited to isolated commands or programs, but increasingly



**Figure 4.** A model of contemporary digital literacy (digital literacies) research.

modulates all aspects of collective life (Mackenzie, 2006). As Berry (2011) argues, it is difficult to separate users' digital activities from the layers of code that condition them. Beneath the hardware itself, code is shaping how *data* is being generated and used; how *algorithms* are processing information; how *interfaces* are structuring user experience; how *protocols* are delimiting what actions are possible within the system; and how *defaults* define standards for usage. In bounding "technology" to objects themselves, our present model of digital literacy offers few resources for tracing how these infrastructures interact with one another—much less how they animate life and work in the digital age. A first step in expanding the terrain of digital literacy, then, might mean reclaiming from the past an attention to the internal complexities of technical systems, and providing both descriptive accounts and prescriptive strategies that can illuminate and guide activities in these domains.

A second set of concerns relates to the *socio-economic dimension* of connective media. Where earlier traditions of computer and media literacy explicitly analyzed the corporate interests shaping media messages (Kellner, 1998) and celebrating investments in technology (Noble, 1984), our inherited model of digital literacy has been more attuned to critiquing commercial content than parsing the workings and extensions of media industries. As with the socio-technical dimension, these earlier lines of inquiry have only grown more important as the economics of digital media are increasingly entwined with even the most prosaic uses of computers. Van Dijck (2013) argues that the socio-technical dimensions of digital media—which include conventional attention to users, technology, and content—are important, but they should not be considered in isolation from their underlying economic relations. For van Dijck, this means examining the *ownership* and profit motives of hardware and software companies; the *governance* structures that adjudicate proper and improper uses of technologies; and the *business models* by which commercial interests operate. Such language provides a path for reviving the long-abandoned economic concerns that were part of earlier traditions in media education. In doing so, it also extends our model of digital literacy to account for the ways empowering acts of digital production—e.g., producing digital stories—and critical readings of media artifacts—e.g., analyzing representations of race or gender in video games—are also forms of labor, which cannot be fully understood apart from inquiry into the economics of platforms. This not only elucidates how connective media blur the boundaries of production and consumption, but also provides a framework from which we can consider the political and ethical implications of these dynamics.

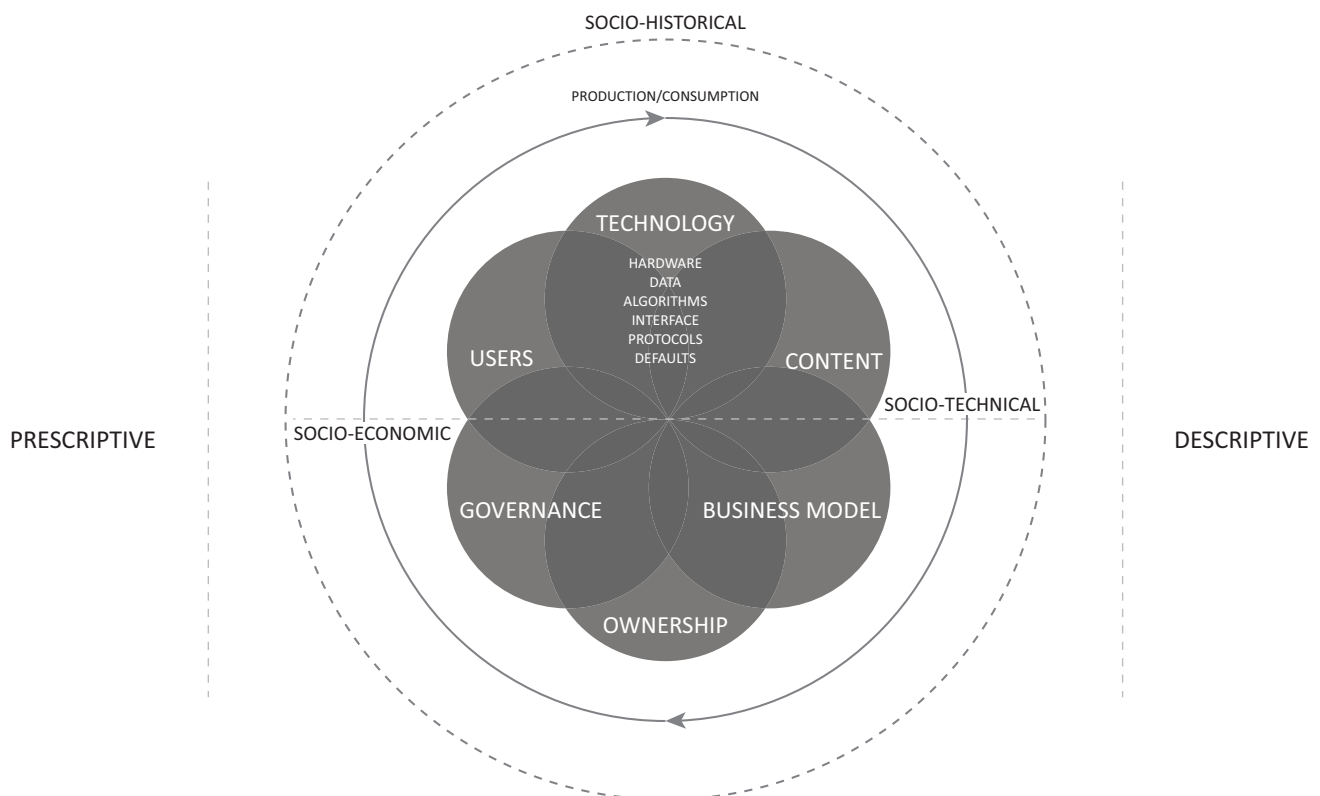
Importantly, we would add that these diverse dimensions of digital media are not static. The technical infrastructures and economic relations that underwrite digital practices are always in motion, adapting to changes within and across their component parts. For instance,

a social networking site might adjust its interface to make sponsored content more prominent, which in turn, might lead users to scale back or adapt their usage patterns. These data points could then be circulated back to the platform and incorporated into subsequent business and aesthetic decisions—which would invariably yield new shifts in activity or revenue. In such an example, user practices and platform properties are mutually constitutive—arising in response to the ebbs and flows of the other. Our present model of digital literacy would struggle to capture this fluidity; however, an expanded framework could carve out space for such analysis by adding a socio-historical dimension to the socio-technical and socio-economic. Such a perspective is not altogether different from the ecological approaches to media literacy that arose in the history of computer education (McLuhan, Hutcheon, & McLuhan, 1977; Postman, 1979). Indeed, even as traditions of "media ecology" have been abandoned in the education literature, they have persisted in media studies, where scholars have found "environments" to provide a generative frame for studying flows of histories, materials, people, and practices (Fuller, 2005; Peters, 2015). Perhaps a form of this tradition might yet find a place in educational research.

Putting these dimensions together, we can begin to map a broader terrain for digital literacy research—one that brings together abandoned concerns from the past with resources of contemporary media theorists (Berry, 2011; van Dijck, 2013; Figure 5). The framework not only opens "technology" to include the technical infrastructures that constitute it (hardware, data, algorithms, protocols, defaults), but also draws on van Dijck (2013) to pair the socio-economic dimension (ownership, governance, business model) with the socio-technical (users, technology, content). In doing so, it foregrounds the imbrication of production and consumption that occurs when these components are layered together: in connective media, consumption always produces datastreams, which are, in turn, consumed by algorithms, if not by other users (cf. Ritzer & Jurgenson, 2010). Further, we can understand the emergent relations between these components as situated in a socio-historical context, an emphasis that aligns with social practice approaches to digital literacies (Lankshear & Knobel, 2008; Sefton-Green, Nixon, & Erstad, 2009). These dynamic relations can be studied both from a descriptive perspective that traces such flows as they occur, or a prescriptive one that delineates strategies for navigating the complex terrain.

Our purpose in laying out this map is not be exhaustive, but to suggest that a multi-dimensional approach to digital literacy—one that reintegrates certain abandoned legacies from the concept's history and emphasizes how social practices always operate in relation to sociohistorical systems and institutions—may be of use in addressing the ethical and political questions that are emerging in education with the spread of connective technologies. Not all of these dimensions will be equally consequen-





**Figure 5.** An expanded model for digital literacy research that includes socio-technical, socio-economic, and socio-historical dimensions.

tial for every research question related to digital literacy, but we diagram them here to illustrate the range of relations that remain under- or un-explored in the education literature. As new media are developed and integrated into educational contexts – from virtual reality to machine learning technologies—we will need more expansive and flexible resources for analyzing their properties, relations, and implications. We offer this map as one framework for re-assembling digital literacy to address these concerns.

## 5. Possible Futures

Just as the histories of digital literacy are shot through with contingencies, there is nothing inevitable about its futures. In the introduction to the *Handbook of Writing, Literacies, and Education in Digital Cultures*, Mills and Stornaiuolo (2018) outline emerging technological developments that frameworks for digital literacy may soon be asked accommodate: the networked Internet of Things, embedded geolocation devices, human-technology interfaces and wearable tech, virtual and augmented reality overlays, new forms of collaborative text production, and personalized data-tracking and analytics. Addressing such a wide range of devices, their technical and economic infrastructures, their possibilities for literacy learning, and their capacities to ameliorate or exacerbate forms of oppression or inequity, will require flexible theories, pedagogies, and methodologies. We have suggested

here that understanding digital literacy as an assemblage of meanings might provide one pathway for expanding the scope of our models to better analyze the social and political relations that flow from these transactions.

But an assemblage approach can also draw our attention to the limitations of such prognostications. It is significant, for example, that imagined futures of digital literacy tend to center on new or changing technologies—the Internet of Things, say, or artificial intelligence. The assumption, in other words, is that future socio-historical contexts for digital literacy will look very much like the present: that the pace and scale of technological development will continue unabated, that digital literacy practices will follow in response to these developments, and that researchers will continue to analyze how power or learning are implicated in these relations. But these configurations need not remain the same. This could be due to some externality that alters our modes of production or standards of living—war, for instance, or global climate change, which will inundate all facets of life in the decades and centuries ahead, including our relations to digital media. But it could also be due to changes in law, policy, industry, design, or pedagogy that might follow from research, activism, and organizing in the present. Put another way, digital literacies research can do more than prescribe skills for navigating new devices or describe practices that emerge with these technologies; it can intervene in the systems that produce them in order to make them more just and equitable.

The assemblage approach outlined above allows us to trace the technical and economic flows that animate digital practices. But crucially, the point is not just to render a more accurate or detailed map of the ways people are exploited, it is to use that map to change the relations that produce exploitation. In research, that might mean addressing policymakers and the general public about the need for ethical technological infrastructures, or even partnering with designers to create alternative devices that adhere to standards for data-protection and privacy. In pedagogy, it might mean introducing students to the forms of ownership and governance that underpin their personal devices and offering pathways to organize against those practices they find invasive. Likewise, teachers and students, together, might put pressure on schools and districts to articulate proactive tech-adoption policies that prioritize student learning and privacy. Such approaches begin to reconfigure the assemblage of digital literacy in ways that promote and sustain the flourishing of teachers and students in the futures yet to come.

## 6. Conclusion

In framing digital literacy as an assemblage, we sought to foreground its historical dimensions, particularly the contingent and contradictory histories of its genealogy across fields. While current uses of the term include both normative catalogs of digital skills and descriptive accounts of people's digital practices, we argue here that these perspectives are not capacious enough to address the challenges posed by emerging mobile and connective technologies—issues of surveillance, algorithmic bias, commercial profit motives, and myriad others. To address these shortcomings, we turned to the concept's foundations in computer, information, and media literacy. We bring those histories into conversation with contemporary theories of connective media (van Dijck, 2013) to suggest different dimensions of the digital literacy assemblage that may be useful for practitioners and scholars—not only the currently emphasized dimensions (users, content, and technologies) and those operating more subtly (governance, ownership, and business), but also the shifting socio-historical context in which these interrelations unfold. Such a multidimensional framework positions educators and researchers to ask complex questions about which dimensions are animated in practice, drawing attention, for example, to the ways hardware, protocols, and interfaces in the technology dimension interact not only with people's practices but also with the development of business models to profit from those uses. Just as there was no inevitability about how digital literacy came to be assembled in current configurations, we see the future of the concept as similarly emergent. We hope this multidimensional orientation is useful in pointing toward those historical aspects of the concept that can help in addressing the complex challenges that lie ahead.

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## Conflict of Interests

The authors declare no conflict of interests.

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